ENGINEERING CHANGE NOTICE

1. ECN 653800

Proj. ECN

2. ECN Category (mark one) Supplemental [] Direct Revision [X] Change ECN [] Temporary [] Standby [] Supersedure [] Cancel/Void []	3. Originator's Name, Organization, MSIN, and Telephone No. Andrew M. Templeton, Data Assessment and Interpretation, R2-12, 373-5589	4. USQ Required? [] Yes [X] No	5. Date 05/25/99
	6. Project Title/No./Work Order No. Tank 241-AZ-101	7. Bldg./Sys./Fac. No. 241-AZ-101	8. Approval Designator N/A
	9. Document Numbers Changed by this ECN (includes sheet no. and rev.) WHC-SD-WM-ER-410, Rev. 0-B	10. Related ECN No(s). ECNs: 612282, 644480	11. Related PO No. N/A

12a. Modification Work	12b. Work Package No.	12c. Modification Work Complete	12d. Restored to Original Condition (Temp. or Standby ECN only)
[] Yes (fill out Blk. 12b) [X] No (NA Blks. 12b, 12c, 12d)	N/A	N/A Design Authority/Cog. Engineer Signature & Date	N/A Design Authority/Cog. Engineer Signature & Date

13a. Description of Change

13b. Design Baseline Document? [] Yes [X] No

This ECN has been generated in order to update the document to reflect results of recent data/information evaluation.

Replace pages:

ES-1 through ES-4, 5-13, 5-14, 6-1, 6-2, and 7-1 through 7-4

14a. Justification (mark one)

Criteria Change	[X]	Design Improvement	[]	Environmental	[]	Facility Deactivation	[]
As-Found	[]	Facilitate Const	[]	Const. Error/Omission	[]	Design Error/Omission	[]

14b. Justification Details

A tank characterization report page change revision is required to reflect the results of recent evaluation of data/information pertaining to adequacy of tank sampling for safety screening purposes (Reynolds et al. 1999, Evaluation of Tank Data for Safety Screening, HNF-4217, Rev. 0, Lockheed Martin Hanford Corporation, Richland, Washington).

15. Distribution (include name, MSIN, and no. of copies)

See attached distribution.

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16. Design Verification Required	17. Cost Impact				18. Schedule Impact (days)	
	ENGINEERING		CONSTRUCTION			
[] Yes	Additional	[] $	Additional	[] $	Improvement	[]
[X] No	Savings	[] $	Savings	[] $	Delay	[]

19. Change Impact Review: Indicate the related documents (other than the engineering documents identified on Side 1) that will be affected by the change described in Block 13. Enter the affected document number in Block 20.

SDD/DD	[]	Seismic/Stress Analysis	[]	Tank Calibration Manual	[]
Functional Design Criteria	[]	Stress/Design Report	[]	Health Physics Procedure	[]
Operating Specification	[]	Interface Control Drawing	[]	Spares Multiple Unit Listing	[]
Criticality Specification	[]	Calibration Procedure	[]	Test Procedures/Specification	[]
Conceptual Design Report	[]	Installation Procedure	[]	Component Index	[]
Equipment Spec.	[]	Maintenance Procedure	[]	ASME Coded Item	[]
Const. Spec.	[]	Engineering Procedure	[]	Human Factor Consideration	[]
Procurement Spec.	[]	Operating Instruction	[]	Computer Software	[]
Vendor Information	[]	Operating Procedure	[]	Electric Circuit Schedule	[]
OM Manual	[]	Operational Safety Requirement	[]	ICRS Procedure	[]
FSAR/SAR	[]	IEFD Drawing	[]	Process Control Manual/Plan	[]
Safety Equipment List	[]	Cell Arrangement Drawing	[]	Process Flow Chart	[]
Radiation Work Permit	[]	Essential Material Specification	[]	Purchase Requisition	[]
Environmental Impact Statement	[]	Fac. Proc. Samp. Schedule	[]	Tickler File	[]
Environmental Report	[]	Inspection Plan	[]		[]
Environmental Permit	[]	Inventory Adjustment Request	[]		[]

20. Other Affected Documents: (NOTE: Documents listed below will not be revised by this ECN.) Signatures below indicate that the signing organization has been notified of other affected documents listed below.

Document Number/Revision	Document Number/Revision	Document Number Revision
N/A		

21. Approvals

	Signature	Date		Signature	Date
Design Authority			Design Agent		
Cog. Eng.	A.M. Templeton	6-3-99	PE		
Cog. Mgr.	K.M. Hall	6/3/99	QA		
QA			Safety		
Safety			Design		
Environ.			Environ.		
Other			Other		

DEPARTMENT OF ENERGY

Signature or a Control Number that tracks the Approval Signature

ADDITIONAL

S

Tank Characterization Report for Double-Shell Tank 241-AZ-101

Andrew M. Templeton
Lockheed Martin Hanford Corp., Richland, WA 99352
U.S. Department of Energy Contract 8023764-9-K001

EDT/ECN: ECN-653800 UC: 2070
Org Code: 74B20 CACN/COA: 102217/EI00
B&R Code: EW 3120074 Total Pages: 150

Key Words: Waste Characterization, Double-Shell Tank, DST, Tank 241-AZ-101, Tank AZ-101, AZ-101, AZ Farm, Tank Characterization Report, TCR, Waste Inventory, TPA Milestone M-44

Abstract: N/A

6/4/99

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RECORD OF REVISION

(1) Document Number: WHC-SD-WM-ER-410

Page 1

(2) Title
Tank Characterization Report for for Double-Shell Tank 241-AZ-101

CHANGE CONTROL RECORD

(3) Revision	(4) Description of Change - Replace, Add, and Delete Pages	Authorized for Release: (5) Cog. Engr.	Authorized for Release: (6) Cog. Mgr. Date
0	(7) Initially released 7/26/95 on EDT 612676.	K. M. Hodgson	J. G. Kristofzski
0A RS	Incorporate per ECN-612282.	M. J. Kupfer	K. M. Hodgson
		MJ Kupfer 7-9-97	K.M. Hodgson 7/21/97
0B RS	Incorporate per ECN-644480	M.J. Kupfer	K.M. Hodgson
		7/22/98	K.M. Hodgson 7/22/98
0-C RS	Incorporate per ECN-653800.	A.M. Templeton	K.M. Hall for
			6/3/99

A-7320-005 (08/91) WEF168

EXECUTIVE SUMMARY

This tank characterization report summarizes the information on the historical uses, status, and the sampling and analysis results of waste stored in the double-shell underground storage tank 241-AZ-101. This report supports the requirement of the *Hanford Federal Facility Agreement and Consent Order*, milestone M-44-08 (Ecology et al. 1994).

Tank 241-AZ-101 is located in the AZ Tank Farm in the 200 East Area of the Hanford Site. The tank, which went into service in 1976, is one of four double-shell tanks designated as aging waste tanks. It was constructed to store neutralized current acid waste, a high-level waste that originated from the reprocessing of irradiated nuclear fuel in the PUREX Plant. Tank 241-AZ-101 first received water in the fourth quarter of 1976. During the next seven years, the tank received a mixture of evaporator feed, double-shell slurry feed, complexed, noncomplexed, and dilute noncomplexed waste from PUREX miscellaneous streams. From 1984 through 1986, tank 241-AZ-101 received aging waste from the PUREX Plant exclusively. The remainder of the fill history of tank 241-AZ-101 consists of a series of small additions of water and dilute noncomplexed waste from tanks 241-AY-102 and 241-AZ-102.

A description and status of the tank are summarized in Tables ES-1 and ES-2 and Figures ES-1 and ES-2. Because the tank is active and could be receiving or transferring water, the volume of supernate and composition of the supernate will likely change. The tank, which has a design capacity of 3,790 kiloliters (kL) (1,000 kilogallons [kgal]), presently contains

3,630 kL (960 kgal) of waste in the form of supernate and sludge. When last measured, it contained 3,500 kL (925 kgal) of supernate (March 1995) and 130 kL (35 kgal) of sludge (September 1990).

This report summarizes three sampling and analysis events. Sludge composition and properties are based upon core samples taken from the tank in April and May 1989. Supernate composition is based on grab samples taken in March 1995 to evaluate waste compatibility. The core samples were taken before the data quality objective process was implemented; therefore, the data may not fully comply with the recent requirements of the waste compatibility data quality objective. The tank was sufficiently sampled to satisfy the requirements of safety screening (Reynolds et al. 1999).

Even though the fuel content of the waste has not been measured by differential scanning calorimetry, the total organic carbon, and the historical uses of the tank suggest that excessive fuel is not present. If the sludge is sampled again, the analyses should include an evaluation of the fuel content by differential scanning calorimetry to confirm the fuel estimates based on historical information and total organic carbon analysis. About 96 percent of the waste is supernate, and the moisture level of the driest sludge is 41.1 percent water, well above the 17 percent safety screening minimum (Babad and Redus 1994). The heat generated by radioactivity in the tank is estimated to be 241,600 British thermal units per hour (Btu/hr)(70,700 watts). The maximum heat load limit for this tank is 4.E+06 Btu/hr. The maximum temperature of the tank ranged from 74.4 to 84.4 °C (166 to 184 °F) for

December 1993 through December 1994. The $^{239/240}Pu$ levels in the sludge were significantly lower than the criticality safety criterion. Based upon this information, the waste does not

Table ES-1. Tank 241-AZ-101.

Tank Description	
Type	Double shell
Constructed	1971 to 1977
In-Service	1976[1]
Diameter	23 meters (m) or 75 feet (ft)
Usable depth	11 m (35 ft)
Design capacity	3,790 kiloliters (kL) or 1,000 kilogallons (kgal)
Bottom shape	Flat
Ventilation	Operating exhauster
Tank Status	
Total waste volume (March 1995)	3,630 kL (960 kgal)
Sludge volume (September 1990)	130 kL (35 kgal)
Supernatant volume (March 1995)	3,500 kL (925 kgal)
Surface level (March 1995)	886 centimeters (349 inches)
Maximum temperature (December 1993 to December 1994)	74.4 °C - 84.4 °C (166 °F - 184 °F)
Integrity	Sound
Sampling Dates	
Two samples	October 1987
Two core samples	April/May 1989
Four grab samples	March 1995
Service Status	
Active service	

[1]The tank received only water during 1976.

Table ES-2. Double-Shell Tank 241-AZ-101 Concentrations and Inventories for Major Analytes of Concern (from Table 4-2).

Physical Properties	Sludge Results[1]		Liquid Results[2]	
Density (g/milliliter [mL])	Core 1 1.28 Core 2 1.67		1.19	
Percent Water[3]	Core 1 41.1 Core 2 45		73.8 (Gravimetric) 73.0 (Thermogravimetric)	
pH	13.6		13.6	
Heat Load	241,600 British thermal units (70,700 watts)			
Chemical Constituents	Sludge Concentration ($\mu g/g$)	Sludge Inventory (kg)	Liquid Concentration ($\mu g/g$)	Liquid Inventory (kg)
Metals				
Al (Aluminum)	24,200	5,320	7,830	32,600
Cd (Cadmium)	4,920	1,070	---	---
Fe (Iron)	87,200	19,100	< 8.40	< 35.0
K (Potassium)	5,700	1,260	---	---
Mn (Manganese)	2,650	4,260	---	---
Na (Sodium)	79,000	17,300	80,000	333,000
Si (Silicon)	5,150	1,130	---	---
U (Uranium)	4,910	1,070	---	---
Zr (Zirconium)	30,900	6,720	---	---
Ions				
NO_2^- (Nitrite)	43,200	9,410	47,700	199,000
NO_3^- (Nitrate)	45,800	10,100	55,500	231,000
SO_4^{2-} (Sulfate)	16,900	3,320	12,900	53,900
Organics				
Total Organic Carbon (μg C/g)	9,180	2,030	866	3,600
Radionuclides	$\mu Ci/g$	Ci	$\mu Ci/g$	Ci
^{241}Am	302	66,600	< 0.0253	< 10.5
^{144}Ce	20.8	3,750	---	---
^{137}Cs	1,480	319,000	1,340	5.57E+06
^{239}Pu	3.58	781	< 3.53E-05	< 0.147
^{240}Pu	1.01	222		
^{106}Ru	37.4	6,800	---	---
^{90}Sr	33,400	6.02E+06	---	---

Notes:
Ci = curies
kg = kilograms
$\mu Ci/g$ = microcuries per gram
$\mu C/g$ = micrograms of carbon per gram
$\mu g/g$ = micrograms per gram

[1]Based on 1989 Sampling and Analysis
[2]Based on 1995 Sampling and Analysis
[3]Based on weight percent total solids determination

Table 5-9. Tank 241-AZ-101 Sludge Projected Heat Load.

Radionuclides	Curies (Ci) (from Table 4-2)	Watts
^{241}Am	66,600	2,190
^{144}Ce	3,750	30
^{60}Co	2,080	32
^{134}Cs	821	8.4
^{137}Cs	319,000	1,500
^{154}Eu	22,300	201
^{240}Pu	222	6.80
^{106}Ru	6,800	65.6
^{125}Sb	19,700	66.0
^{90}Sr	6,020,000	40,400
Total watts		44,500

upon these analytical values, is still significantly lower than the safety screening criterion for criticality of 1 g/L. The criticality specifications also require the pH of waste to be greater than 8.0 when the plutonium inventory exceeds 10 kg, and the depth of the supernate liquid exceeds 30 cm. The supernate depth in tank 241-AZ-101 exceeds 30 cm and the Pu inventory is approximately 18 kg. The pH of the supernate is 13.6, which satisfies the criticality prevention specification.

The flammability of the gas in the tank head space is another safety screening consideration. Analysis of tank head space is outside the scope of this report.

Historical and analytical information do not show that the waste composition exceeds the safety criteria for water content, heat, or criticality. Even though the fuel content of the waste has not been measured, the values for DSC, TOC, and historical uses of the tank suggest that excessive fuel is not present. The tank was sufficiently sampled to satisfy the requirements of safety screening (Reynolds et al. 1999).

5.5.2 Operational Evaluation

The 1995 supernate sampling and analysis were performed to evaluate the compatibility of waste for transfer to another tank. Sampling and analysis requirements for assessing waste compatibility have been addressed in the *Waste Compatibility Data Quality Objectives* (Carothers 1994). This objective is based on safety and operational considerations. Operational considerations include pumpability, waste segregation, heat generation, tank waste type, and high phosphate waste. The 1995 supernate results are compared to the key compatibility criteria in Table 5-10 (results from Table 4-2). The assessment shows

Table 5-10. Compatibility Assessment for Tank 241-AZ-101 Supernate.

Parameter	Criteria	1995 Results
$^{239/240}Pu$	$<$ 0.05 g/gal (0.8 μCi/g)[1]	$<$ 3.53E-05 μCi/g
Specific Gravity	$<$ 1.41	1.19
Energetics	exotherm/endotherm $<$ 1	No exotherm observed
Corrosivity[2]	0.01 $\underline{M} < [OH^-] <$ 8.0 $\underline{M}$ $[NO_3^-] <$ 1.0 $\underline{M}$ 0.011 $\underline{M} < [NO_2^-] <$ 5.5	$[OH^-]$ = 0.67 $\underline{M}$ $[NO_3^-]$ = 1.06 $\underline{M}$ $[NO_2^-]$ = 1.20 $\underline{M}$
Transuranics	$<$ 100 nCi/g	$<$ 25.4 nCi/g
Total organic carbon	$<$ 10 g/L	1.03 g/L

Notes:

μCi/g = micorcuries per gram
nCi/g = nanocuries per gram

[1]Based upon ^{239}Pu specific activity and an assumed supernate density of 1 g/mL.

[2]Corrosivity decision rules were not developed for the aging waste tanks in the *Data Quality Objectives for the Waste Compatibility Program* (Carothers 1994) waste compatibility DQO because aging wastes are no longer generated with the permanent shutdown of the PUREX Plant (Carothers 1994). Instead, the wastes stored in Tank 241-AZ-101 must comply with the corrosion specifications listed in Operating Specifications for Aging Waste Operations in 241-AY and 241-AZ (Bergmann 1989).

that the nitrate concentration does not meet the primary criteria. In this situation the waste compatibility data quality objective requires that the following two conditions be met:

For 1.0 $\underline{M} < NO_3^- \leq$ 3.0 $\underline{M}$

1. $0.1\,(NO_3^-) \leq OH^- < 10\,\underline{M}$

2. $OH^- + NO_2^- \geq 0.4\,(NO_3^-)$

These two conditions are met for tank 241-AZ-101.

The low phosphate concentration (131 μg/mL) observed in the 1995 grab samples indicates that the potential for insoluble phosphates forming is low, and the waste is pumpable.

6.0 CONCLUSIONS AND RECOMMENDATIONS

The sludge in tank 241-AZ-101 was sampled and analyzed in 1987 and 1989; the supernate was sampled and analyzed in March 1995. Historical and analytical information indicate that the waste composition satisfies the safety criteria for water content, heat, and criticality. Although the fuel content of the sludge has not been measured by differential scanning calorimetry (DSC), the total organic carbon (TOC) and historical tank uses indicate that excessive fuel is not present. The tank was sufficiently sampled to satisfy the requirements of safety screening (Reynolds et al. 1999). If the sludge is sampled again, the analyses should include an evaluation of the fuel content by DSC to confirm the fuel estimates based on historical information and TOC analysis. Tank 241-AZ-101 meets the criteria specified in the waste compatability DQO (Carothers 1994).

As expected the sludge contains large quantities of aluminum, iron, manganese, sodium, and zirconium as expected from PUREX chemical processing wastes. Concentrations of nitrate, nitrite, and sulfate are high also, as expected. The major radioactive constituents in the waste are ^{90}Sr, ^{137}Cs, and ^{241}Am. The heat generated by these isotopes is well below the 4,000,000 Btu/hr limit set for aging waste storage tanks.

The supernate $^{239/240}$Pu and ^{241}Am levels are below the transuranic classification limit of 100 nCi/g. However, the sludge significantly exceeds the transuranic classification limit.

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Name	MSIN	Text With All Attach.	Text Only	Attach./ Appendix Only	EDT/ECN Only
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B. C. Simpson	R2-12	X			
A. M. Templeton	R2-12	X			
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